A Theory-Driven Perspective on Strategic Decisions Under Uncertainty

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Background

This note focuses on *decisions* as the unit of analysis of strategic management. Camuffo et al. (2023a) develop a framework for understanding strategic decisions that builds on past work on framing strategic problems (Nickerson and Zenger, 2004) and the theory-based view of the firm (Felin and Zenger, 2009; Zenger, 2016; Felin and Zenger, 2017). The framework represents strategic decisions as spaces of attributes linked by logical connections. Attribute are sets of alternative uncertain realizations of the relevant elements of the strategic problem.

For example, suppose that a strategist identifies three attributes of a problem: *competition*, *technology*, and *profitability*. We can represent these attributes as sets with dichotomous realizations: $X_c = \{s, w\}$; $X_t = \{g, b\}$; $X_p = \{h, l\}$, with initials for *strong* and *weak*, *good* and *bad*, and *high* and *low*. This defines a space $X = X_c \times X_t \times X_p$ made of the eight triples that we can form from the realizations of the three attributes.[1] We call these triples "states" and X the *space of states*.[2]

Ex-ante, the strategists have a belief about the probability of the realization of each one of the eight states. The map or function $p(x_c, x_t, x_p)$ represents the probability of the state (x_c, x_t, x_p) made of three specific realizations of the attributes X_c, X_t, X_p. For instance, $p(s, b, h)$ is the probability of observing (s, b, h) in the future. We define the probabilities of the other seven states analogously.

Strategists learn by establishing logical links among attributes. Table 1 defines the five basic logical links from which we construct more complex logical links. Logical links concentrate probabilities on a subset of states. For example, suppose that our strategists establish a conjunction between X_c and X_t – that is, they conjecture that in order to observe $X_p = \{h\}$, they need to observe both X_c =

[1] With n attributes made of m realizations, the space X will have m^n sets made of n realizations. With continuous realizations, the space X is made of infinite n-tuples of real numbers.

[2] Scenarios is an alternative term for states.

$\{w\}$ and $X_t = \{g\}$. This concentrates probabilities because they will set probability zero to the three states of the space X in which $X_p = \{h\}$, and X_c or X_t are not $\{w\}$ and $\{g\}$, and they will increase the probabilities of the subset made of all the other five states of X. We can use any other logical link in Table 1 to exclude states of X that contradict the logical link.

Table 1 about here

More generally, logical links modify the probabilities that strategists define on the space X because they reduce the probability of states that contradict the logical links and reallocate these probabilities to states consistent with the logical link, which become more likely. Logical links are theories: They explain why some states of the problem that they have defined are less likely to be observed.

Beliefs Within and Across State Spaces

Strategists know that they deal with beliefs and that beliefs may not be true. In our problem there are two levels of beliefs:

1. beliefs about the *logical links* within the given state space
2. beliefs about the *state space*

In the case of beliefs about logical links, strategists formulate a *null hypothesis*. A null hypothesis is a different probability distribution on the state space of the problem, X in our example. For instance, the alternative logical link is that a good technology will be imitated, and therefore it will produce strong competition (an *if* statement). The null hypothesis would be that all the states with $X_t = \{b\}$ and $X_c = \{s\}$ have probability zero (or lower).

The strategists will set a belief ω, which is a probability, on the probability distribution defined by the logical link that they conjectured, and a belief $1 - \omega$ on the probability distribution defined by the null hypothesis. Suppose that they are interested in the probability that the company is profitable, which is $p(X_p = h)$. This probability is equal to the sum of the probabilities of all the states in X in which $X_p = \{h\}$. The strategists define two probabilities $p(X_p = h)$, one under the main hypothesis and one under the null hypothesis. The probability that profits will be high is the average between these two probabilities, weighed by the belief ω. Thus, the stronger the belief in the strategists' theory – that is, in the main hypothesis – the closer is the expected $p(X_p = h)$ to the probability defined by the strategists' theory rather than the null hypothesis, and vice versa.

The belief about the state space of the problem is an important ingredient of our framework in that it introduces explicitly the fact that strategists know that they are dealing with Knightian uncertainty –

that is, they are aware that *there may be state spaces other than the one that they defined that they are not aware of*. To discuss this point, it helps to distinguish between *low-frequency* and *high-frequency* strategic decisions (Camuffo et al., 2023b). The former are “rare” decisions, such as the decision to acquire a new company, launch important innovations, or change the firm’s business model, capital structure, or governance. The latter are more ordinary, and typically less important, decisions, such as decisions about to operate a manufacturing line, or the details about a marketing campaign, or about the organization of some firm’s standard projects.

High-frequency decisions rely on past data in similar contexts and close analogies (e.g. a manufacturing operation for a new product similar to existing products). This makes strategists confident of the state space that they have identified. Low-frequency decisions, instead, do not rely on past data or analogies. Strategists imagine a new “world” (e.g. e-commerce in the 1990s, or the outcome of an important acquisition in the history of the company), which they have never seen and it is mostly in their mind. Therefore, they know that other state spaces are possible. However, because these alternatives state spaces are unknown, the strategists cannot define them. The best they can do is to identify an alternative problem in which they define new attributes and logical links – an *alternative theory* – and a null hypothesis on this alternative theory. Like in the previous case, they determine probability distributions on this different world, including beliefs about alternative theory vis-à-vis null hypothesis.

They compare the “plausibility” of the two theories and state spaces. The belief ω affects the extent to which strategists believe that their theory is plausible against the null hypothesis in a given state space. With high-frequency decisions changes in ω only affect the decision to commit to the probability distribution of the main vs null hypothesis in this state space. With low-frequency decisions, strategists also consider the effect of changes in ω on the expected probability of success in the current state space (where the expectation averages out the possibility that the probability distribution may be the one of the main or null hypothesis). Suppose that, in a given state space, the probability of success under the theory is higher than under the null hypothesis. A stronger belief ω in the theory raises the expected probability of success within this state space. This makes it more likely that strategists commit to the underlying state space as opposed to the state space of the alternative theory, and vice versa for a weaker belief ω.

For example, Camuffo et al. (2023a) discuss the case of Luxottica, a leading multinational company in fashion glasses, which in the 1970s developed its strategy for fashion glasses and compared to it an alternative theory about its traditional business based on standard glasses for eyesight defects. Luxottica did not know whether the state space of fashion glasses (a market that at that time did not exist, and they could only imagine) was plausible. They had a strong belief on the logical link that a good fashion design generated demand. This raised the plausibility of this state space against the alternative state space in which they stayed with their standard business.

In our framework, strategists envision an alternative state space, while Knightian uncertainty speaks of states that strategists cannot observe or conceive. But the point is that the best they can do is to compare the plausibility of their main space and theory with something else that they envision. This provides a cautionary benchmark to assess the plausibility of their theory against the unknown. It is a better solution than paralyzing the decision because the future cannot be described, or ignoring that the state space that they have envisioned is not the only state space.

Our framework also articulates the distinction between problem framing and solutions. Defining alternative state spaces is the search for the problem to solve. Had Luxottica concluded that the theory of standard glasses was more likely to produce a desired outcome, it would have focused on solving that problem, developing strategic details; and vice versa when it established the plausibility of pursuing fashion glasses. Our framework resonates with Peter Thiel's distinction between the path from zero to one, and the path between one and infinity (Thiel, 2014). The path between zero to one depends on a coarse assessment of whether an opportunity is plausible. The path between one to infinity defines details.

Positive or Normative Framework?

Our framework provides a positive and normative representation of strategic behavior. The choice of a set of attributes, a state space, stems from intuition (gut feelings). On top of it, from Table 1, strategists can think in terms of causality, necessary or sufficient conditions, associations, and they can form more complex logical links from the five basic ones. This resonates with the incipit of Ludwig and Mullainathan (2024) who argue that "science is curiously asymmetric": Ideas originate from intuition, inspiration and creativity, but, once created, they are developed and tested according to a structured process.

Some strategists may focus on one attribute and work only on gut feelings. Others may be paralyzed and not know which attributes to prioritize. Yet others, may ignore alternative theories or believe that state space they envisaged is the only plausible one, or they may use logical links in a contradictory way. Our framework is then also normative. Strategists ought to follow a protocol in which: a) they prioritize attributes and connections by settling on what they believe is a plausible state space; b) develop a null hypothesis about alternative probability distributions (or "plausible" outcomes) on the same space; c) set beliefs on the main theory and the null hypothesis; d) develop an alternative theory as a benchmark that takes into account that the state spaces that you envisage are not objective. Our experimental evidence is that entrepreneurs who adopt this approach: i) are more likely to terminate projects in the short-run (Camuffo et al., 2020; Camuffo et al., 2024); ii) are less likely to terminate them in the long-run (Coali et al., 2024), which suggests that they terminate worse projects; iii) are more focused in their pivots (Camuffo et al., 2024); iv) generate higher revenues conditional on survival (Camuffo et al., 2024).

A more important question is the extent to which strategists act or should act as pure scientists (Camuffo et al., 2020; Zellweger and Zenger, 2023). As pure scientists, they think of probabilities as likelihoods of exogenous states that they cannot influence. In this case, mental models are purely predictive, and strategists develop actions that maximize benefits given the predictions about future states.

A different perspective dates back to Simon (1996), and claims that strategists can shape the world. Rindova and Martins (2021) provide a thorough perspective of this “design-based” view. In this case, strategists do not take future states as granted, especially when they receive negative signals. They react to these negative signals by undertaking actions that try to change the course of events. For example, a pure scientist-strategist who obtains a signal that competition is tighter than expected, updates beliefs (whether on the probability distribution or state space), and may decide to pursue the alternative theory. In the design-based perspective, the strategists would think, instead, of new attributes and actions that reduce competition (e.g. seeking patents). They do not switch, but keep pursuing the goal they set, and carry out new actions that raise the odds lowered by the negative signal.

Gambardella and Messinese (2024) argue that strategists adopt a mix of these two approaches. They provide experimental evidence in which entrepreneurs nudged by the scientific approach are more likely to terminate and perform better upon survival than a control group, while entrepreneurs nudged to react with actions to negative signals terminate less and perform better than the control group. This suggests that scientist-strategies may terminate projects that, with some actions, turn out to be profitable.

Our framework encompasses both approaches. The question boils down to where the probabilities come from. According to a design-based perspective, they are not meant to predict future states irrespective of actions that can change the environment. A low probability of an attribute can be countered by actions that raise this probability. Compared to a pure theory-based perspective, a design-based perspective is then more likely to pursue the main theory of the strategists. They will use actions to make this theory more likely, while the pure theory-based perspective will switch to different theories more frequently, and will be more cautious about the potential of their current theories.[3]

Experiments

Strategists learn about their theories and state spaces through experiments. They can experiment on one or more logical link, or on the plausibility of the realization of one or more attributes. For example, they can experiment that weak competition *and* good design are necessary for high profitability, or that competition is likely to be weak or design is likely to be good. They can run one experiment on a specific logical link or on the plausibility of a specific attribute, or on more of these elements jointly, while keeping the other probabilities on other elements of the problems, or on other logical links, at the level pre-specified by the theory. Moreover, these experiments could be real or they could be conjectural experiments in the minds of strategists. Finally, they could be experiments on the main theory or the alternative theory.

We leave all these issues in the background, and focus on what we think is a first-order point of our framework. Experiments could update (1) the probabilities within a given state space or (2) the belief ω. An update of the probabilities in a given state space is a minor adjustment. It is a classical Bayesian update. Given the state space, signals update probabilities in one or the other direction. The update of the belief ω is more fundamental. A limitation of Bayesian updating is that it does not provide a rule to update states whose probability, before the update, is equal to zero. These are events that strategists are either unaware of or that they think are impossible. As noted earlier, the update of ω can affect the strategists' belief on whether they should commit to the state space of the main or alternative theory. This is equivalent to asking the question *whether the update is on the probability distribution of a given state space or on the state space*.

We do not have a good solution to this problem, but a fair characterization of it is to say that experiments that produce signals close to what strategists expect – that is, not very distant from what their theories predict – change beliefs on the plausible probability distributions on a given state space. Signals that produce information that contradicts substantially a very low ω or a very high ω are more likely to induce changes in ω. The focus on very low or high ω is important. They represent a strong belief that the main theory is true or false vis-à-vis the null hypothesis. Strong contradicting evidence of this strong belief may not just prompt them to say that the theory or the

[3] We may also argue that design-based strategists do no think in terms of probabilities. But our probabilities are subjective, and every decision-maker has a notion of plausibility in mind when making decisions under uncertainty. Our key distinction is really whether they think that they can change the plausibility of scenarios through actions, or they take this plausibility as granted and test different scenarios (hypotheses or alternative theories) against each other.

null hypothesis is wrong, and we should follow one or the other, but that the whole way of framing the problem is not ideal, and the world might look different from what they thought. They then switch and commit to the alternative theory and state space (Ortoleva, 2012).

For instance, very strong evidence that strong competition and good design does not lead to high profitability, may not just update downward the probability that strong competition and good design generate high probability of high profits. It may prompt strategists to question that they have focused on the relevant state space, and conclude that they have to focus on different attributes.

Strategists may take deliberately this approach of questioning the foundations of their strategies. Because they know that their state space may not be "true", they may run *killer experiments* (Gans, 2023). Killer experiments are biased experiments aimed at contradicting the state space of the strategist. For instance, strategists may look for contexts in which, *ex-ante,* weak competition and good design are most unlikely, and test whether profitability is high in any case. This would suggest that profitability is high even if competition is strong and design bad, and therefore for this problem other attributes and state spaces are important. If the state space was objective, there would be no need to use signals or to design experiments aimed at affecting ω to learn whether it is the right state space.

Conclusions

This note laid out a proposal for a positive and normative framework to make strategic decisions under uncertainty. The framework needs to be complemented with future research to develop it and address at least some of its limitations. Ideally, this framework could help to understand decision-making under uncertainty in strategic management, and provide a basis to produce theoretically-founded tools to support these decisions in practice.

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Table 1: Five Basic Logical Links

x_i	x_j	*conjunction* $x_i \wedge x_j$	*Inclusive disjunction* $x_i \vee x_j$	*exclusive disjunction* $x_i \oplus x_j$	*implication* $x_i \Rightarrow x_j$	$x_i \Leftarrow x_j$	*biconditional* $x_i \Leftrightarrow x_j$
T	T	T	T	F	T	T	T
T	F	F	T	T	F	T	F
F	T	F	T	T	T	F	F
F	F	F	F	F	T	T	T
		and	*or*	*not both*	*if*		*if and only if*

Let x_i and x_j be two realizations of attributes X_i and X_j. The first column reports whether we observe the realization or not (true or false). The other columns report whether, according to the logical link, we observe or not the consequent statement.